THE PREVENTION OF ONION SMUT

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[1]In cooperation with the College of Agriculture, Ohio State University, Columbus.
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BULLETIN

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THE PREVENTION OF ONION SMUT

By A. D. SELBY

The work of the Botanical Department of this Station in the way of preliminary experiments was published in Bulletin 122; the experiments to be covered in the present discussion were the result of confining attention to the most successful remedies as therein indicated. These remedies are dilute solutions of formaldehyde, commercially known in forty percent. strength as formalin, sprinkled upon or sown with the seed, and applications of ground quicklime, applied to the soil just previous to planting. The results have fully justified previous indications and appear to be entirely satisfactory, so far as successfully carried out.

PLAN OF EXPERIMENTS IN 1901

Owing to the considerable distance from the Station of the onion growing regions with smut infested soil the general plan of the work was, as heretofore, cooperative. Through the continued interest of Mr. Fred Schreiner, Jr., of Chillicothe, it was arranged to make experiments upon three different tracts of smutted soil devoted to onion set growing at Chillicothe, namely, upon the land of Mr. Schreiner, upon land belonging to Mr. Jno. Heinzelman and upon that controlled by Mr. H. G. Griesheimer.

For all these tracts the history is very much the same; upon that of Mr. Schreiner the last previous onion crop had been smutted badly and had been immediately followed by another crop in 1900.

The land of Mr. Heinzelman had grown onions in 1900, but the crop was badly smutted and would not have been planted save for demonstration purposes. With the land operated by Mr. Greisheimer a crop of onions, in part badly smutted, had immediately preceded.

In addition to this work on smutted land devoted to set growing, arrangements for experiments were made with Messrs. O. L. Smith & Son, Berea, O., who have smutted soil upon which they

grow market onions. The soil at Berea was last year in onions following corn; after harvesting the onions the ground had been sown to rye, which was in turn plowed under immediately previous to the year's onion seeding.

In the experiments at Chillicothe, and at Berea as well, the plot arrangement was essentially the same, namely, untreated plots interspersing plots with at least two strengths of formalin solution and two or more different rates of lime application.

The planting was done April 1 and 2 on the plots at Mr. Schreiner's and Mr. Heinzelman's, Chillicothe. The lime applications were also made on the Greisheimer lot, but the seed was not sown nor the formalin applications made until two or three days later, owing to rains. As subsequent events proved, this date, April 1, 2, was a favorable time for the seeding on these lots, but a period of later drought was severe. At Berea the seeding was not done till May 7, and owing to subsequent heavy rain and flood the stand was unsatisfactory; on the plots where formalin had been applied the stand was half or less, and this was the best attained. The plots at Mr. Schreiner's were the only ones seeded to our entire satisfaction. At Mr. Heinzelman's the wind was so high as to make the seeding very uneven and incomplete. The same applies with more or less force to the lot at Mr. Griesheimer's, while at Berea the season was so far advanced that a satisfactory stand seemed problematical and the fears in this respect were realized.

The sets at Chillicothe were gathered at the usual time and the results reported by Mr. Schreiner and Mr. Heinzelman. At Berea the yields were estimated by Mr. Smith.

RESULTS OF EXPERIMENTS IN 1901

This table gives the outcome of the work at Mr. Schreiner's:

RESULTS OF ONION SMUT WORK ON FARM OF MR. FRED SCHREINER, JR., CHILLICOTHE, O.—CROP, ONION SETS.—1901. (PLOTS EACH 760 SQUARE FEET)

Plot	Treatment	Smut noted by Mr. Schreiner May 27	Actual yield—pounds	Calculated yield per acre—pounds	Calculated yield per acre—bushels	Increase percent
1	†Lime, 34 bus. per acre.....	A good deal of smut...	121.6	6969.0	174.2	32.2
2	Lime, 70 " " "	Some smut.....	152.0	8711.0	217.8	65.2
3	Formalin‡ .375 or 3-8% solution	Very little smut.....	196.0	11232.8	280.8	113.0
4	Nothing	Very bad.....	*92.0	5272.5	131.8	.....
5	Formalin .75 or 3-4% solution..	Hardly any.....	202.0	11576.6	289.4	119.6
6	Lime, 125 bus. per acre.....	Could not be better....	203.0	11633.9	290.8	120.6
7	Lime 70 bu. and formalin .375 or 3-8% solution.....	Could not be better....	214.0	12264.3	306.8	132.8

* The 92 pounds of sets here included were *large* and less valuable; 32 pounds of pickle onions were also obtained.

† Lime—in all cases ground quicklime applied by repeatedly going over with fertilizer drill, seeding with hand drill.

‡ Formalin applications were made by sprinkler on scattered seeds as described in Bulletin 122; for the 3-8 percent. solution approximately 1 ounce formalin was used in 2 gallons of water. Seeding here was by drum and hoe covering.

The season was less favorable than has sometimes been known for very large yields. The untreated plot yields 30 bushels less per acre than the untreated plot of last year on similar soil. The treated plots gave yields much in excess of the same plots of 1900. The substantial agreement of the results with formalin solution and with heavy applications of lime show that each is about equally effective.

At Mr. Heinzelman's the drilled seed of the untreated and limed plots was not disturbed so much by wind, though doubtless the lime applications were. The results were as follows:

On untreated plots, yield 154.3 bushels per acre.

On lime plots , 70 bushels per acre, yield 171.6 bushels per acre.

On formalin plots, .50 percent, yield 202.4 bushels per acre.

By reason of the unsatisfactory conditions of the experiment it seems well to pass these results without further discussion.

No satisfactory report can be made of the other set of plots at Chillicothe. At Berea the stand was so poor that mere mention suffices. The untreated and limed areas gave at the rate of about 35 bushels of onions per acre, while the formalin treated areas yielded about 170 bushels per acre. From observations of the experiment Mr. Smith is convinced that the formalin will be an effective remedy under suitable conditions. He is desirous of trying this remedy again.

CONCLUSIONS AND RECOMMENDATIONS

There seems to be adequate demonstration, by the season's experiments 1901, of the superior effectiveness of dilute formalin solutions and of heavy applications of ground lime for the prevention of onion smut in infected soils. The indications of 1900 are supported by the additional results. On the matter of exact statement of the probable increase of yield of onions or onion sets by the use of these remedies, the results are not conclusive, though more adequate than a year ago.

As to strength of formalin solution to be employed, the tentative recommendations of Bulletin 122, 3-8 percent. to 1-2 percent. solutions of commercial formalin in water are supported; on plot 5 where a 3-4 percent solution was used, the results are slightly more favorable than with the 3-8 percent. solution of formalin on plot 3, yet it is not certain that such strengths may not prove slightly unfavorable to germination, when applied with drill. Upon a small disconnected area a solution of 1.00 percent formalin indicated considerable unfavorable influence. It is likewise apparent that the formalin should be applied by attachment on the seed drill. Such was easily arranged at Berea by using an old maple syrup can with

perforated bottom, closed at pleasure by a plug, with tin tube to carry the solution forward to drop with the seed. Here in drilling single rows the difficulty was slight. With the five row system of set seeding at Chillicothe or elsewhere, it will be necessary to increase the size of the container for the solution to nearly 10 gallons and to multiply the number of drip tubes by five. Aside from the slight expense connected wlth the device and a little care to provide for a suitable shut-off arrangement while turning, no difficulties are apparent; these, indeed, should not prove serious.

The application of the solutions of formalin by such drip attachment to the onion seed drill is recommended, both to avoid other dangers, as from wind, and to insure greater evenness of application. An attachment suitable for onion set seeding is now being planned for next year's use.

For applicafions of ground lime, which is now obtainable on the market,* the fertilizer drill attachment is satisfactory and suffers only the disadvantage of requiring one to go over the ground four to seven times. The drill used at Chillicothe would sow only about 17 bushels per acre by once going over the ground. The application by hand is very difficult, so that the drill is the best method known at present.

The residual effects of the lime treatment on the onion soils must be left to the future. It would seem possible, by use of these two remedies of formalin and lime combined, or of either separately to continue profitable onion growing on smutted soils, and possibly to reduce the smut infection. The matter of the eradication of the smut entirely must be left for future determination.

Rotation is always good practice in field culture and is by no means to be disregarded. I would not suggest the abandonment of rotation; rather its continuance.

There is no basis of accurate comparison as between the methods of onion smut prevention herein set forth and other treatment for the same smut in other states. Thaxter's sulfur and lime treatment has proved successful in New York.† There onion yields have been increased above 160 percent by this treatment. Since, however, it was on large onions where yield possibilities are so much greater, this scarcely constitutes a parallel. So far as our own trials have proceeded, the formalin and lime, as before described, have proved the most successful in onion smut prevention.

* That used by the Station in 1901 was purchased of the Seneca White Lime Co., Fostoria, O.

†Bulletin No. 182, New York Agricultural Experiment Station, by F. A Sirrine and F. C. Stewart, December, 1900.

SUMMARY

This bulletin records briefly the continuation of previous experiments for the prevention of onion smut in infected soils.

The methods employed have been those indicated in Bulletin 122 namely, ground quicklime and forty per cent. formaldehyde, commercially known as formalin.

To apply formalin, use at rate of 1 pound commercial formalin in 25 to 33 gallons of water (1 ounce to 1 1-2 or 2 gallons) and apply with drip attachment on seed drill at rate of 500 to 700 gallons of solution per acre for onion set seeding (about one-fifth to one-fourth as much for field onions) or apply with sprinkler upon the scattered seeds until well moistened, then cover with earth promptly.

Apply ground quicklime or stone lime, better the former, at the rate of 75 to 125 bushels per acre just before seeding, on the freshly prepared soil. If applied by drill, harrowing will not be required; if broadcast, harrowing should precede planting.

These methods are sufficiently established to warrant general use on smutted soils devoted to onions.

TO MAKE FOMALIN SOLUTIONS OF APPROXIMATE PERCENTAGES

To make a three-eighths or 375 percent. solution, use 1 ounce commercial formalin in 2 1-12 gallons of water, or 1 pound formalin in 33 1-3 gallons of water.

To make a one-half or .50 percent. solution, use 1 ounce formalin in 1 1-2 gallons of water, or 1 pound in 25 gallons.

To make a three-fourths or 75 per cent. solution, use 2 ounces of formalin in 2 1-12 gallons of water or 1 pound of formalin in 16 2-3 gallons of water, or 2 pounds in 33 1-3 gallons of water.

Since the formalin is a liquid which may be purchased in pint bottles a pint may be taken to be equal to 1 pound and a fluid ounce equal to one ounce named above. The 1 ounce, 2 ounce, 4 ounce and 8 ounce bottles of the druggist deliver fluid ounces; an 8 ounce or 16 ounce graduate is very convenient in such work.

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